

Expertise

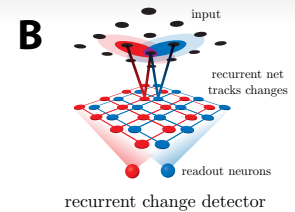
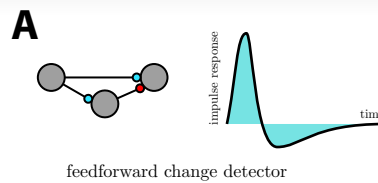
Computational neuroscience;
Machine learning; Deep learning;
Compressive sensing

Research themes

The brain looks for *change*
The brain weighs the *uncertain*
The brain is deeply *nonlinear*

change

Circuit motifs for change detection
across time and space

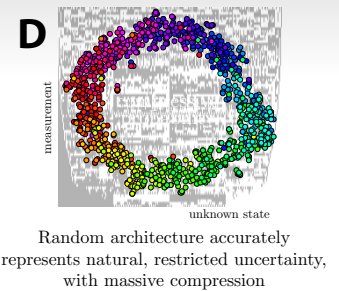
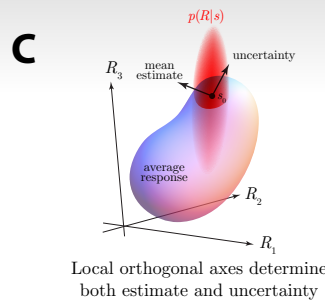


uncertainty

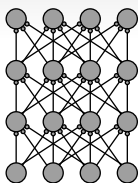
population codes can represent
exponential family distributions
using nonlinear sufficient statistics:

$$p(s|\mathbf{r}) \sim \exp[\Theta(s) \cdot \mathbf{R}(\mathbf{r})]$$

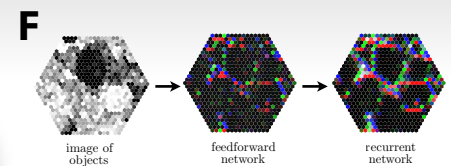
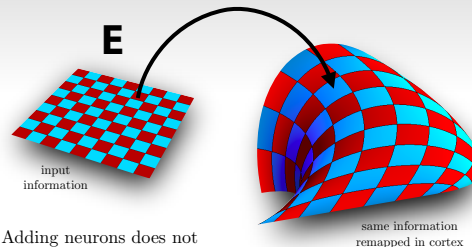
random nonlinear networks allow
efficient representation and probabilistic
computation (marginalization, integration)



deeply nonlinear



Deep architecture bends representations,
makes nonlinear information accessible



Primary visual cortex is consistent with
message-passing algorithms for inference:
connectivity mirrors statistical correlations.

unification

Cortical computations use deep, nonlinear recurrent networks to
create internal models of the natural world and infer hidden states,
by reformatting and integrating sense data while respecting uncertainty.

Biological data about cortical connectivity and nonlinear responses
constrain our understanding of approximations these inferences use.

HELP WANTED

Computationalists seek functional
connectomicists for fruitful collaboration

Finding cortical computing primitives requires a
computational framework plus experimental data
about both *structural connectivity* and *nonlinear
response properties*.

We would like to partner with experimentalists
who record activity and anatomical connectivity
in mammals. (978) 460-5144 or xaq@rice.edu

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